

RESEARCH ARTICLE

Pairing colours in residential architecture for different interior types

Begüm Ulusoy¹  | Nilgün Olguntürk²  | Rengin Aslanoğlu² 

¹Interior Architecture and Design, School of Design, University of Lincoln, Brayford Pool, Lincoln, LN6 7TS, UK

²Department of Interior Architecture and Environmental Design, Faculty of Art, Design and Architecture, Bilkent University, Ankara, Turkey

Correspondence

Begüm Ulusoy, Interior Architecture and Design, School of Design, University of Lincoln, Brayford Pool, Lincoln, LN6 7TS, UK

Email: BUlusoy@lincoln.ac.uk

Abstract

Most colour studies focus on single colour effects; however, interiors are multi-coloured environments and contemporary users are looking for more innovative colour schemes in interiors. Interior architects rely on their own subjective experience and instincts when they take up the challenge. This study aims to reveal colour semantics of paired colours on walls for different residential interior types (eg, living room) as a second part of the previous study conducted by the same authors. Both studies explore colour semantics through 42 Munsell colours (with variety of hues, value, and chroma levels) with 14 adjectives (eg, beautiful, unpleasant, cold) under controlled conditions. The predecessor study had explored single colour meanings, however, in this study, participants were asked to pair colours for the same residential interior types on the same semantic scales. Thus, its results can be compared to single colour data on different residential interior types through same methodology and participants. Results reveal that all colour attributes affect semantics paired wall colours. Orange is associated with negative meanings more whereas yellow hue induces positive meanings more for all adjective pairs, except cold-warm and feminine-masculine. For positive association, lighter colours and less saturated colours are selected more compared to saturated and darker colours. Comparing results of single colour study and the current study reveals that pairs cannot be anticipated through single colours for all residential interior types and adjectives, and positive adjectives tend to require different colours than their single associations in their pairs.

KEYWORDS

architecture, colour, interiors, pairs meaning, residential

1 | INTRODUCTION

Colours affect interior experience as a “basic aspect of human perception”^{1(p645)} so that it has been studied as an

important colour-material-finishes property in several subject areas, including some design disciplines: industrial design, interior architecture, and architecture.²⁻⁵ Colour experience is context dependent in design disciplines and

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its context affects experience, preference, and perception.⁶ Users rely on its context to prefer/enjoy/hate a specific interior space through specific colour schemes. Design disciplines provide a medium to explore how complicated those connotations are: some colour associations are shared by different design disciplines, however, there are significant differences for other colour associations even if they are related to different interior types in the same interior typology. For example, regardless of context, green arouses positive meanings in the previous studies about two different disciplines: interior architecture and brand design.^{7,8} On the other hand, the product design study claimed that white is associated with “elegant”⁹ whereas the interior architecture study revealed that it is related to “soft, simple, and objective,” which are considerably humble associations compared to elegance.^{7(p269)} Consequently, colour is a context depended concept for design disciplines, therefore, generalizations are hard to rely on and exploring colour effects in interiors (or in other design disciplines) within different contexts and concepts is an essential responsibility of researchers in these fields.

Experiencing colour is a strong feeling, therefore, people tend to think it is a shared experience. Furthermore, colour associations can be either concrete or abstract.¹⁰ However, colour experience is a complicated concept ranging from universal associations (red-warm)¹¹ to very personal ones. This is related to colour perception, which “relies on our cognitive organs, and it is all but impossible to share an experience that is intimately subjective.”^{12(p10)} That leads some colour researchers in design disciplines to explore the concept in its context and create reliable guides. A previous study^{13(p2)} introduced colour meanings of red, green, blue, and yellow: red is related to “excitement, tension, unpleasantness, anxiety, anger and warmth,” green is associated with “comfort and stability,” blue arouses “comfort, stability and coolness,” and yellow induces warmth. Kaya and Crosby¹⁴ conducted an inspirational study that reveals how different building types (including residential buildings) and colour preference are related to each other through emotional associations, and their results proved that all three attributes of colour have an influence on colour preference. Furthermore, the study concluded that people acquire those emotional associations through knowledge and experience, and since they tend to decrease arousal, lighter and less saturated colours are preferred for residential buildings, which are related to a calming atmosphere of a home. Therefore, blue (less arousal due to tranquility and relaxation associations causing calming effect) and red (their users’ past encounters: the brick colour of their own residential buildings’ façades) are associated to the residential building type more.¹⁴ The same previous study¹⁴ demonstrated that in residential building types, purple is the least favorite colour. A web-

based study aimed to create a framework by using “girl,” “boy,” “romantic,” and “modern” keywords to harvest data through internet.¹⁵ This study’s results indicated that “romantic” keyword attained more colour in living rooms than “modern,” and more pinkish and bluish colours are revealed for “girl” and “boy” keywords, respectively in a kids’ room.¹⁵ Another study¹⁶ examined living rooms and showed colour associations on their walls: red-“disgust and happiness,” green-“happiness,” and blue-“neutral.” Ulusoy and Olguntürk⁷ conducted a free-association study in interiors with comparing semantics of single and paired wall colours. Their study findings proved that single and paired colours might carry different meanings: the red-green colour pair on a wall evokes meanings of “different” and “contrast,” however, single red (warmth and strong) and single green (calming, home, and soft) are associated with more affective meanings. That might be result of overstimulation in interiors,¹⁷ which cause loss of meaning for these colours.⁷ Meanings of colours have been appealing to researchers and raise public interests for decades. Colour combinations and man-made environments, particularly interiors, were mentioned by Smith,^{18(p4)} who stated that they “become important in the formation of the identity and impression of that interior for the viewer.” Besides, when people are experiencing an interior with “its surfaces, volume and scale, their experiences are influenced by the impact of colour interaction.”^{18(p4)} Interiors and interior architects have more options in terms of materiality, they can supply wide variety of colours as painting walls (or other surface finishes), and however, reliable sources to guide them through applications of those colours are exceedingly rare.

An earlier study¹⁹ revealed that building types and room functions are affecting colour preferences (according to Slatter and Whitfield^{20(p1068)} and Taft^{21(p41)}). There is the “inherent natural reason for different colour preferences on different surfaces,” therefore, some colours arouse specific meanings in different interior types.^{22(p942)} Van der Voordt et al²³ conducted very interior specific study that explored colour preferences in four different interior types: an office, a meeting room, a living room, and a bedroom, which are interior types of two essential interior typologies: workspaces and residential spaces. Their study findings revealed that white was the most preferred colour in all interior types whereas only brown was preferred in a living room more than 10%. Thus, the study proved that the same colour can be preferred in very different interior typologies/types (eg, a meeting room and a bedroom), however, there are differences in interior types (eg, bedroom and living room) of the same interior typology (residential interiors). Colour is mentioned as a storyteller and a strong tool for communication of designer and their clients, although, “the subjective nature of colour” might discourage designers

from embracing more innovative colour palettes.^{24(p7)} On the other hand, decision makers (interior architects, designers, architects, and users) mostly have to rely on their instincts, experience, and hearsay to create a required atmosphere. White is preferred in workspaces and residential spaces more than other colours; nevertheless, the driving force of this preference can be habituation or stereotype.²³ Similarly, Lluich,¹² discussed dominance of white in colour applications of modern architecture to be a misunderstanding thus creating positive associations of “white” in interiors, consequently, many decision makers prefer to use white more than other colours. Nonetheless, earlier studies²⁵⁻²⁷ proved white wall colours in offices have negative effects on mood and performance. The previous study mentioned that “a more solid colour chart including a detailed information about colour attributes” is needed during design process so that decision makers would have sources to use colourful charts instead of dull white colour on interior walls.^{22(p941)} An overall colour chart in interiors, which reveals colour semantics in relation to emotions and preference, requires more colour research in different typologies (eg, residential interiors) and their interior types (eg, bedroom for residential interior types [RITs]). Thus, this study is exploring paired wall colours by contributing realization of colour semantics for decision makers and future researchers while excluding achromatic colours in order to overcome contaminating variables such as habituation and/or stereotypes.

A theoretical framework of the study is based on the claim that our understanding of a scene is formed by “visually perceived properties” and that expectations originate from a scene's (or a product's) interpretation.^{28(p45)} By claiming walls and their colours are design components of interiors Hutching et al²⁸ underscored importance of walls and how they constitute users' understanding of interiors. Moreover, previous researchers indicated that colour associations are related to past encounters¹⁴ and experience creates associations and meanings.²⁹ When a user is surrounded by walls as a design component, they recall their knowledge and experience to interpret a meaning. In addition, Arnkil et al^{30(p46)} stated that visual qualities (eg, colour, light) cannot be evaluated in isolation since visual experience, which is “one and undivided” is “spatial, holistic, dynamic and contextual.” As a result, in this study, participants were asked to assess scenes according to their respective knowledge and memories hence collecting associations and meanings of colour pairs. When a user encounter with a design component, they are interpreting that design component to connote a specific meaning regarding to their own experience and knowledge. By asking participants to recall their knowledge and memories, the study aims to obtain colour semantics. This study tries to provide a colour chart for paired colours on RITs' walls

and pertain the predecessor study²² by connoting interior-specific meanings with different attributes of colour. It was hypothesized that;

- Some RITs would have the same colour, which they were associated with in the single colour study²² when asked for their colour pairs. However, some RITs may reveal different colour charts regardless of their single colour associations.
- In addition, some colour pairs may be related to a specific colour connotation regardless of RITs, whereas some colour pairs may be associated with different meanings in relation to their RITs.

The study's findings will reveal how colours occur within pair relationships on interior walls through their connotations and clarify colour meanings further to enhance communication on colour-meaning associations between interior architects and their users/clients, which is one of the main challenges during design process.

Scott³¹ compiled alteration strategies under the theory so as to prove that interior architecture relies upon changes, interior architects' response to those changes and a good practice of alteration. His approach is referring “striping back” to investigate a guest building's existing surface layers and response to its heritage while treating its interior walls. Changes in interiors require more research and more reliable sources to guide decision makers during their design process in interiors. All interiors (buildings and designs) are destined “to remain unchanged, to be altered or to be demolished.”^{31(p1)} Therefore, changing and adapting to a new circumstance of life is the main aim of most interiors unless they are demolished (an undesirable option) or are preserved (a highly unlikely option for many cases). Colour applications offer transformations of an interior through flexible, rapid, and cheaper modifications. Interior architects have been transforming and altering artifacts since change is essence of the discipline as well as it is required by their users, thus more sophisticated and visually complex interiors are needed and created. Moreover, offering innovative interior experience to users relies on more research-based process, thus interior architects and designers are embracing research methods more and are looking for more reliable sources throughout their design process.²² More reliable sources in spatial design process are in demand and decision makers credit research studies in the field more than ever before. Slatter and Whitfield²⁰ stated that users judge appropriateness of colour according to an interior's function through exploring living rooms and bedrooms. Similarly, Smith¹⁸ stated that users evaluate an interior's function through its created atmosphere in which colour is one of the dominant

factors. The previous study²² proved that some RITs are associated with different colours and their functions feature prominently in those connotations. During design process, functions of colour accompany functions of space, therefore, decision makers need to assign colours, which correspond to desired function by their users. Effects of colour through interior surfaces on user experience is well established knowledge, even if research studies on the concept are rare. There are previous studies on colour semantics in interiors, nonetheless more research studies are needed to clarify how meanings of surface colours are varying in different interior typologies and in different RITs within their interior typology regarding their different functions. Although there are interior architecture studies (eg, Ulusoy and Olguntürk⁷), which explored paired colour effects in interior experience, there is a gap in the literature about semantics of colour pairs in different RITs referring to their different functions. The aim of the present study is to investigate meanings of paired colours in different RITs and contribute to the overall colour knowledge, by comparing paired colour associations to their single colour associations²² hence provide a reliable source for decision makers and future researchers.

2 | METHOD

2.1 | Present study

The present study aims to explore paired colour meanings in different RITs and compare them to the previous study,²² which revealed colour semantics in different RITs as single colours. Considering buildings types and colour preference¹⁴ are related to all three attributes of colour, 42 chromatic colours in the Munsell Book of Colour, which present variety of hue, value, and chroma, were shown as stimuli to the participants under controlled conditions as the previous studies^{14,22} (see Appendix A). Colours were presented as numeric codes (eg, 5YR 7/10 was 3) (see Ulusoy et al²² for the full list). Five opposite adjectives (beautiful-ugly, elegant-vulgar, loud-discreet, masculine-feminine, and warm-cold), which were employed in the previous study,²¹ were investigated with comfort (comfortable-uncomfortable) and pleasantness (pleasant-unpleasant) because they are related to residential interiors.²²

2.2 | Participants

The study was conducted in Turkish with volunteers, who had good command of the language and were residents of Ankara for 2 or more years. They did not receive

any encouragement and/or payment. The previous study showed an inclination toward no gender difference for colour emotions in the RIT: living room,¹⁶ so there were four males and 16 females, totaling to 20 participants. All of the participants were asked to use their corrective lenses, if necessary, and self-stated that they were not colour-blind. The same group of 20 voluntaries, who participated the predecessor study, whose average age was 26, completed the colour pair sheet after the single colour sheet. They were invited to the study by snowball sampling³² from Interior Architecture and Environmental Design and Architecture departments. Participants needed to spend a long time for the experiment since they needed to recall their memories, employ their knowledge, and engage with colours and the study. Considering long experiment duration (average: 53 minutes, minimum: 35 minutes, and maximum: 89 minutes), volunteers, who were particularly interested in this colour study were called to avoid experimental mortality, which occurs “when some research participants do not continue throughout the entire experiment.”^{32(p295)} The sampling strategy guaranteed the very sensitive volunteer sample group who were willing to spend time for colour consideration and were interested in colour studies in interiors instead of a sample group who either would quit (experimental mortality) or would complete the study because of social/peer pressure. Although, they seemed few in numbers, the sample group is representing both residential interior users (as the target group) and decision makers, who are interested in colours and have respective knowledge.

2.3 | Experimental conditions

Experimental conditions were same as the predecessor study: participants completed a sheet for single colour-associations first and then continued with another sheet for colour pair associations under controlled conditions of the experiment room. Before the experiment, participants received and filled the information form and signed the consent form in the experiment room without any window. First, participants selected single colours, which they associate to an adjective for each RIT. Then, on another sheet, they were asked to select two colour codes as wall colours to pair for 10 different RITs and 14 adjectives. Same 42 colour chips that cover different attributes of Munsell Book of Colour (hue, saturation, and brightness), were used for both single and paired colour studies thus comparing their results can represent difference between colour semantics in interiors for both single and paired colours. Interior lighting conditions were kept under control because they could affect colour viewing significantly.³³ A viewing box was employed for answering demographic questions

and selecting associated colours, which provided 480 lx-controlled viewing conditions. Konica Minolta T-1 Illuminance Meter (with range of 0.01 to 99 900 lx) was used to measure the box's average illuminance. Osram duluxstar mini twist 13w 865 (colour temperature: 6500 K and colour rendering index: >80) was used to fulfill required viewing conditions in the box. There was no time limitation and participants were free to select the same colour for 10 RITs, both single colours and paired colours, and/or 14 adjectives. In this study, the same 10 RITs were investigated: entrance, living room, corridors, kitchen/ dining room, toilet, work room, balcony, bathroom, kid's room, and bedroom.

3 | RESULTS AND DISCUSSION

3.1 | Colours in pairs

IBM's SPSS Statistics 26 was used to analyze data, through Frequency Tests. In order to explore hue versus brightness-saturation effect in addition to hue effect, colour codes were analyzed through colour names: orange, red, green, purple, blue, and yellow. Table 1 demonstrates colour names and adjectives frequencies and Table 2 compares most frequent colour names to the previous single colour studies.

Colours, which are chosen 100 times or more covers 25% or more of total data of their respective adjectives. Some scales such as feminine (red: 215) shows very high agreement on hues, however, others such as pleasant (yellow: 107 and green: 104) implies that there might be two (or more, for example, cold) colours dominating these scales (see Table 1). Negative meanings tend to have more orange hues whereas positive meanings tend to have more yellow ones. In the previous study, Taft²¹ mentioned orange as the loudest and ugliest colour, which corresponds this study's findings even if these two studies explored colour in different contexts: product types and RITs. In addition, the same previous study mentioned ratings of orange on semantic scales did not

vary between two contexts: colour chips and objects.²¹ Findings of the current study correspond to the previous study's findings that ratings of orange might not be context depended and might be generalized to several concepts such as interiors, products, chips, etc. For the current study, cold-warm and masculine-feminine are exceptions, which do not convey orange-negative versus yellow-positive connotations as other scales. Cold (followed by green and yellow) and masculine has more blues, warm has more orange colours, and feminine has more reds (see Table 1). It cannot be generalized that either yellow or orange has positive or negative associations on these scales. Yellow and orange colours dominate colour choices regardless of RITs on many scales (see Table 2), which proves saturation and brightness can affect colour meaning in RITs in addition to hue for paired wall colours. These results agree with the previous studies' results.^{14,22,34} Ulusoy et al²² stated that single interior wall colours' meanings are affected by hue, saturation, and brightness. According to Kaya and Crosby,¹⁴ all three attributes affect colour preference for building types.¹⁴ Furthermore, an earlier study³⁴ claimed that emotions are affected by brightness and saturation; therefore, colour emotions can be related to colour preference and colour meaning in interiors. For instance, yellow and orange hues can induce both negative and positive meanings in interiors (eg, ugly-beautiful, comfortable-uncomfortable) (see Table 2). Comfortable and uncomfortable scales share same two colour names (yellow and orange), however, comfortable scale reveals less saturated and lighter tones per contra uncomfortable scale are related to more saturated and darker ones (see Table 3). This corresponds to the previous study,¹⁴ which stated lighter colours and less saturated colours are preferred for residential buildings more since they decrease arousal. Similarly, Table 3 reveals that lighter and less saturated colours tend to arouse more positive meanings than darker and more saturated colours as mentioned in the previous studies.^{14,22}

Kaya and Crosby,^{14(p70)} mentioned purple as the least favorite colour, although, it was related to shopping malls

TABLE 1 Frequency of hues that are mentioned in a pair, for all residential interior types (RITs) (regardless of its RITs), (the highest frequencies are presented in bold)

	Col	Wa	Fem	Masc	Disk	Lo	Vulg	Eleg	Ugl	Beau	Unple	Ple	Uncomf	Comf
Orange	45	147	98	62	91	104	157	90	147	76	128	77	126	84
Red	32	93	215	24	19	78	39	45	36	60	54	48	72	35
Green	95	47	23	56	73	59	70	76	70	89	83	104	79	86
Purple	27	13	16	37	10	43	74	19	66	26	55	28	35	16
Blue	107	14	8	165	38	20	20	39	11	39	17	34	13	35
Yellow	90	86	40	55	145	94	38	129	68	108	61	107	73	138

TABLE 2 Comparison of most frequent colours to previous studies

Adjectives	Taft 21	Ulusoy et al 22	Results of current study
Cold	Turquoise, chartreuse	Blue, green, yellow, purple	Green, Yellow, Blue,
Warm	Red, orange, brown	Orange, red	Orange, Yellow, Red
Feminine	Pink	Red, orange	Red, Orange
Masculine	Gray, brown, blue	Blue, green, purple, orange	Blue, Green, Orange
Discreet	Gray, beige, blue, brown	Yellow	Yellow
Loud	Orange, yellow, chartreuse	Orange, yellow	Yellow, Orange, Red
Vulgar	Chartreuse, orange, yellow	Orange	Orange
Elegant	Red, blue	Orange, red, yellow, green	Yellow, Orange
Ugly	Orange, chartreuse, brown	Orange, purple, red	Orange, Purple, Yellow
Beautiful	Red, blue	Green, yellow, red, blue, orange	Green, Orange, Yellow,
Unpleasant	NA	Orange, green, purple, yellow, red	Orange, Green
Pleasant	NA	Green, orange, yellow, red	Orange, Red, Yellow, Green
Uncomfortable	NA	Orange, red, yellow	Orange, Yellow
Comfortable	NA	Orange, yellow, red	Orange, Yellow

TABLE 3 Most frequent colour(s) that are mentioned in a pair, for all RITs, in comparison to the single colour study (Ulusoy et al 22) (differences between two scenarios in bold) (frequency in parenthesis)

RITs	Cold	Warm	Feminine	Masculine	Discreet	Loud	Vulgar	Elegant	Ugly	Beautiful	Unpleasant	Pleasant	Uncomfortable	Comfortable
En (S)	15	2, 3	9	1	40	2	1	6	1	15	1, 2, 15	4, 15, 18	1	4
En (P)	15(7), 40(7)	3 (5)	9 (7)	32(5), 33(5), 34(5)	40(10)	2 (7)	1(11)	40 (9)	1 (8)	6(5), 18(5)	1(5), 2(5)	6(5), 40 (5)	1(6)	40(9)
Co (S)	15, 35	3	9	1, 33	40	2	1	6	1	15, 40	1	40	1	40
Co (P)	40 (6)	4 (6)	6(6), 9(6)	32(5)	40(12)	2(6), 36(6)	1(8)	40 (8)	1 (6)	6(5), 18(5)	1 (7)	4(5), 40(5)	1(5), 2(5)	6(7), 40(7)
LR (S)	15	3	8	1	40	2	1	6	1	17	1, 2, 5, 15, 24, 39	6	1	6, 40
LR (P)	35 (6)	3 (4)	9(5), 10(5), 14(5)	33 (5), 1(5)	40 (9)	2 (6)	1 (10)	40 (8)	22 (4)	40 (7)	5 (5)	6(4), 11(4), 40(4)	2 (5)	6(7)
Ki/DR(S)	31	3	14	1, 33, 34	40	2	1	11	1, 2	17	1	4	1	4
Ki/DR(P)	40 (6)	3(4), 40(4)	11(5)	17 (6)	40 (8)	2 (7)	1(7)	40 (10)	1 (7)	6(4), 40(4)	1 (7)	15(5), 40(5)	1(5), 2(5)	40(7)
Bic (S)	40	3	8	33	40	2	1	40	1	11, 40, 42	1, 10	40	1	40
Bic (P)	15 (6)	40 (6)	8 (7)	33(5), 17(5)	40(10)	2(4), 3(4), 40(4)	1(6)	6(7)	1(6)	40(5)	1(4)	6(5), 40(5)	1(4), 2(4), 39(4)	40(8)
Toi (S)	30, 31, 35	4, 7	12	32	40	2	1	6, 15, 40	1	35	5	15	2, 13	40
Toi (P)	40 (7)	3(4), 4(4)	6(6)	32(6), 34(6)	40(12)	2(4), 40(4)	1(11)	40(8)	1(6)	6(5), 40(5)	1(5)	40(5)	2(6)	40(6)
WR (S)	17, 31, 40	4, 11	6, 11	17, 33, 34	40	2	1	6	1	6, 15	1	6	2	4
WR (P)	40(8)	3(4), 40(4)	11(5)	1(9)	40(12)	2(5)	1(7)	40(9)	2(6)	6(5), 40(5)	20(5)	40(6)	1(5)	40(6)
BR (S)	35	4	8	32, 33	40	2, 36	1	6	1	40	1	15	1, 2	40
BR (P)	40(7)	4(4)	6(6)	32(6), 34(6)	40(11)	2(4), 40(4)	1(12)	40(8)	1(4), 2(4), 39(4)	6(5), 40(5)	1(5)	40(6)	2(6)	40(6)
KR (S)	15	2	9	25, 30	40	2	1	40	1	18	1	15	1	6
KR (P)	40(5)	40(6)	8(6)	29(4), 32(4)	40(8)	36(6)	1(9)	40(6)	1(8)	40(5)	1(4)	18(6)	2(5), 39(5)	40(6)
BER (S)	27, 31, 40	11	10, 11, 13	32, 33, 34	40	2	1	11	1	11	1	11	36	11
BER (P)	40(5)	11(5)	8(7)	33(6)	40(8)	11(4), 13(4)	1(10)	6(7)	1(7)	40(6)	2(4), 20(4)	40(5)	2(5), 39(5)	40(6)

and entertainment buildings because purple was associated with being “fun and creativity.” Similarly, it can be stated that yellow and orange have either positive or negative meaning in RITs because they are relevant to its context and function, however, purple is not relevant.

Purple has neither positive nor negative associations in most RITs because it might be perceived as irrelevant and unexpected in houses. The single colour study proved that purple is not selected as much as other colours and when it is associated with a meaning in an RIT,

it is associated with negative meanings more, which might be related to this phenomenon, purple is about fun and entertainment, thus should not be in a calming (or even in unquiet) house. In contrast with previous interior architecture studies, which demonstrated that green, as a single colour, is related to “home” and “calming,”⁷ “happiness” (for living rooms)¹⁶ and “beautiful” and “pleasant” (for several RITs),²² the present study’s results do not reveal a lot of green colours for positive adjectives as part of paired wall colours (see Table 3 and Appendix B). These previous studies’ results are based on single colours, which might be interpreted as there being a difference between single colour and paired colour associations. Similarly, Kaya and Crosby,¹⁴ who investigated relationship between building types and colour preferences, stated that blue colours were selected more in residential buildings. The present study finds that blue colours are not the most selected hue for RITs as to pair with another colour. However, there are few exceptions (such as kids’ room and comfort pair), where blue colours mostly appeared on the masculine scale (see Appendix B). These differences between studies might be due to context difference (RITs vs residential building type and RITs vs a vacant interior without assigning a function) or methodology differences. Alternatively, blue and green hues might have exceptional conditions for pairs, which could make them less desirable or relatable on interior walls.

Comparing this study results to the predecessor single colour study revealed that, some RITs require same or very similar colour palettes in both scenarios (single colour scenario and paired colours scenario on RITs’ walls) (see Table 3). Moreover, similar to the previous study, some colour meanings are strong that they are not changing either in different RITs or in different scenarios. For example, “40” (beige) and “1” (orange) were selected for “discreet” and “vulgar,” respectively, for all RITs and for both scenarios. Both hues were mentioned by a previous study²¹ as colours, which are not context depended (for colour chips and objects), which is in a similar vein to the current study. Similarly, the predecessor study²² stated that regardless of RITs, “1” 5YR 3/6 (orange) is related to vulgar and arouses negative associations (such as ugly). Besides, the same colour is related to uncomfortable, unpleasant, ugly, vulgar, and masculine as part of colour pairs. It can be interpreted that, creating positive experience in interiors can be achieved by avoiding this colour on walls. Furthermore, despite three exceptions (loud-balcony, loud-toilet, and loud-bathroom), “40” (7.5Y 9/4) (a.k.a. beige) is associated with positive meanings (see Table 3). This colour is ostensibly manifested as a positive impulse for RIT walls. Comparing single colour’s and paired colours’ results revealed that positive meanings

such as beautiful, pleasant, and elegant tend to require different colours in their pairs than their single colours (see Table 3). That corresponds with the previous study,²² which stated that positive meanings required more complex and sophisticated colour charts compared to negative meanings. Moreover, Ulusoy and Olguntürk⁷ stated that single colours and their pairs might convey different meanings, which agree with the current study’s results.

Furthermore, the study results reveal that there is a high agreement on some colours to be paired in different RITs for a variety of meanings. Table 3 shows that 12 scale-RIT pairs contain a colour, which was selected 10 times (or more) that corresponds 25% (or more) of all pairs of their respective RITs. Besides, only five scale-RIT pairs (warm-living room, warm-bathroom, ugly-living room, unpleasant-balcony, and unpleasant-kids’ room) have a colour, which has a frequency result of four times that corresponds to 10% frequency rate of all pairs for their respective RITs (see Table 3). Rest of scale-RIT pairs have a colour with frequency results between 10% and 25% (see Table 3).

3.2 | Paired colours

Colour pairs, which were selected more than once were analyzed (IBM’s SPSS Statistics 26) to reveal how pairing single colour are related to RITs and adjectives. As it is expected different hues are having different tendencies: red colours are dominated with “feminine” meaning whereas blues and purples are mentioned with “masculine.” Similarly, to the predecessor study, purple is not selected a lot for RITs for either positive or negative meanings. However, in contrast with the previous studies²² some purples pertain to positive meanings: pair “28-35” (with 10 PB 5/6): comfort in kids room and pair “14-26” (with 10 PB 5/10): comfort and pleasantness in toilet and comfort in bathroom (see Appendix B). The previous study¹⁴ has not related purple to residential building types, although, they revealed that purple can be preferred in shopping malls and entertainment buildings, which are public entertainment spaces. Despite these two purples appearing in toilet/bathroom/kid’s room, purple in residential interiors is not appreciated as much as other colours in this study. Nonetheless, purples are not related to a living room or a bedroom in which people spend more time. Therefore, it can be ostensibly argued that positive associations of purple depend on RITs and the other colours (for this study purples are paired either red or blue for positive connotations), which they are paired on interior walls.

The study findings showed that 40 (7.5Y 9/4), which is a pale light yellow (a.k.a. beige) is paired with other colours in order to induce positive meanings: comfort,

pleasant, beautiful, elegant, cold, warm, and discreet in addition to masculine and feminine (see Appendix B). For instance, for comfortable scale it is paired with following colours: 15 and 42 in entrance, 15 in corridors, 35 and 42 in kitchen and dining room, 4 and 6 for toilets, 17 for workroom, 42 in balcony, 4 and 6 in bathroom, 15 in kids' room and 17 in bedroom. Similarly, 40 (7.5Y 9/4) appears on positive meanings on the Table-3 with few exceptions for loud and cold scales, with only 10% for loud in three RITs (balcony, toilet, and bathroom). It is interesting to note that the colour is paired with a green in a living room for masculine, and an orange in a kids' room for feminine, which ostensibly proves that colour pairs' associations are related to RITs (more private and less private RITs) and could be manipulated through pairing colours. All RITs are assigned to 40 for the scale discreet and mostly they have higher agreement (minimum: 20%, maximum: 30%) as two previous studies proved that discreet and beige are related to each other.^{21,22} The single colour study claimed that the same colour is associated with discreet for all RITs and discreet is perceived as a positive meaning since residential interiors need to be calming and relaxing, which conflict with being loud.²²

The previous study²² demonstrated that cold hues are related to cold and warm hues are related to warm adjectives. In contrast with this study, the present study findings show that some RITs have cold hue pairs for warm adjectives such as bathroom and toilet (see Appendix B) and vice versa (entrance, corridor, and workroom). In addition, only cold-living room pair has blue colour, nevertheless both cold and warm adjectives have warm hues (see frequency results on Table 3). That might be explained by pairing blue with another colour may cause loss of meaning and overstimulation, which is not desirable.¹⁷ Furthermore, this interpretation corresponds to results that show both "green" and "blue" are not the most selected colours in pairs even if previous studies^{7,14,16,22} revealed that they are desirable and preferable in RITs.

4 | CONCLUSION

Colour applications in interiors have been terrifying students, professionals, and even educators all around the globe for decades. As Batchelor^{35(p22)} mentioned chromophobia, which is defined as "loathing of colour," is a deep-rooted problem in design and architecture in addition to be a "fate of Western culture." Caivano^{36(p356)} quoted Pelli³⁷ who stated that:

"When I was a student of architecture in Tucumán, Argentina, I learned that proper,

serious Modern architecture should have no colour except for the colours of natural materials, whites or grays—anything else was frivolous or decadent. In the years after the Second World War, students of architecture in progressive schools all over the world must have learned the same lessons."

Lluch¹² pointed out that generations of architects and designers (also users) have this "almost mythical concept" of using white for modern architecture. White colour applications of modern architecture are misunderstood¹² and leave achromatic colour schemes to contemporary decision makers who have found themselves in a very challenging situation. Lluch¹² proposed several inspiring exercises to overcome that considerably universal design problem for decision makers to embrace colour during their design processes. However, colour applications in interiors need more research studies and industry applications in order to cope with this widespread mythical misunderstanding. Changing wall colours to improve interior experience is widespread, low cost and a low maintenance solution, which is already being used by decision makers in order to handle toilsome interior issues: creating positive effects on users, arousing positive emotions, providing positive experience, etc. or sometimes just for a fresh start in a new room for a new life.

There are many stereotypes around colours. Van der Voordt et al²³ argued that habitation and stereotypes can affect colour preferences in residential interiors and workspaces, therefore, white might be preferred more over other colours. Ulusoy et al^{22(pp949-950)} state that stereotypes on gender caused "the masculine adjective might accompany negative meanings on residential wall colours" because residential interiors might be intuitively associated with being female as a domestic private interior typology. Aforementioned studies^{12,35} argued the preference of white due to prejudice to chromatic colours schemes. Decision makers need to create desired effects intentionally not intuitively. Since the study results proved that, as its predecessor study on single colours, colour pairs are harder to predict for positive associations, therefore, positive effects are harder to create compared to negative effects. It is assumed that a majority of decision makers aim to arouse positive meanings in interiors thus creating those positive impulse through colours requires sophisticated solutions. Those solutions can only result from systematic enquiries of researchers whose effort will develop an overall colour chart of colour semantics in interiors. This study aimed to contribute this final outcome. On the other hand, residential interiors have been neglected more than other interior typologies

until Covid-19 pandemic made us remember that they are our unique interiors and their design will be more important in this decade since they are now functioning as offices, gyms, movie theaters, etc. Not only designers, but also users wish the pandemic would end soon, however, when it ends, it will leave behind a new world, in which residential interiors might be the most important designed space. Therefore, interior architects and interior educator should pay more attention of this forgotten interiors.

Results of the current study proved the hypothesis that some RITs are associated with the same colour regardless of their scenario (single colour scenario and paired colours scenario on RITs' walls) whereas other RITs can be pertained to different colours in different scenarios. Moreover, it was hypothesized that some colour pairs will be associated with different meanings regarding to their RITs whereas some other colour meanings are so strong that would not change either in different RITs or for different adjectives. This hypothesis was not rejected by the study findings. However, in addition to single and paired colours on RITs, further investigation is required to prove this hypothesis. Similarly, further investigation is required to prove that "vulgar"—"1" and "discreet"—"40" associations can be valid for every possible scenario, for instance, colour combinations with three or more colours or different interior design elements such as floors, ceilings, furniture, etc. The study findings proved that paired colour associations are affected by all three attributes of colour, and lighter and less saturated colours are related to positive meanings in RITs more as suggested by the previous studies.^{14,22}

This study contributes to understanding how colours affected meaning in interiors as pairs on walls for different RITs. It provides a new perspective and several outcomes to be discussed in order to contribute collective colour knowledge further. Future studies need to explore colours, colour pairs and colour combinations on different RITs with not only wall colours but also different surfaces (eg, ceilings) and different interior architecture elements (eg, furniture). The field is very complicated that cannot be covered by few experimental studies, however, more interior architecture studies (like the current study) about this topic with different methodologies would reveal impeccable strategies, which can be used in industry by decision makers. The current study and its predecessor study hope to initiate a series of studies about colour semantics in relation to colour preference and colour emotions, thus will constitute a colour application guide in terms of interior architecture. Therefore, future studies need to investigate colour in relation to these concepts through different typologies and their interior types within a typology.

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DATA AVAILABILITY STATEMENT

The data that support the findings of this study are available from the corresponding author upon reasonable request.

ORCID

Begüm Ulusoy  <https://orcid.org/0000-0002-5714-6575>

Nilgün Olguntürk  <https://orcid.org/0000-0001-7947-1101>

Rengin Aslanoğlu  <https://orcid.org/0000-0002-8002-5069>

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AUTHOR BIOGRAPHIES

Begüm Ulusoy is a senior lecturer in the Department of Art, Architecture, and Design, School of Design, University of Lincoln, Lincoln, United Kingdom. She received BA (Hons.), MFA, and PhD degrees in interior architecture and environmental design. Her current research embraces research methods, interior experience, colour, and material applications in interiors. Her current teaching includes Research Process in Spatial Design. Dr Ulusoy is, an active member of the International Commission of Illumination (CIE); the International Colour Association (AIC); the Inter-Society Color Council (ISCC); Colour Group Great Britain (GB) and Chamber of Interior Architects of Turkey, and worked as a member of the Board of Directors (Ankara) for Chamber of Interior Architects of Turkey.

Nilgün Olguntürk is an associate professor in the Interior Architecture and Environmental Design Department, Faculty of Art, Design, and Architecture at Bilkent University, Ankara, Turkey. She received BArch, MA, and PhD degrees in architecture. Her professional experience has included appointments as instructor at the Middle East Technical University, research fellow at the London South Bank University, and Department Chair at Bilkent University. She has studied in the US and Italy, and worked on research projects in the UK. She has 20 years of research and experience on colour perception, colour preference, and colour use in architecture and interior architecture. Her current research and teaching include colour, lighting, and design studios. Dr Olguntürk is an active member in the CIE, the AIC, the ISCC, the Colour Group Great Britain, and the UIA, Chamber of Architects of Turkey.

Rengin Aslanoğlu received BA (Hons.), MFA, and PhD degrees from the Interior Architecture and Environmental Design Department at Bilkent University Ankara, Turkey. The Cover Image of *Color Research and Application Journal* (2019, Volume 44-6) was




































based on one of her studies. Her research interests include perception of color and effects of artificial lighting on attention and performance and her teaching includes theory of color and lighting design.

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APPENDIX A: 42 chromatic colours used in the experiment

Orange	Red	Green	Purple	Blue	Yellow
5YR 3/6 (1)	2.5R 6/8 (8)	2.5G 9/4 (15)	10PB 4/12 (22)	7.5PB 6/10 (29)	7.5Y 8.5/12 (36)
5YR 7/14 (2)	2.5R 7/8 (9)	2.5G 5/8 (16)	10PB 4/10 (23)	7.5PB 5/10 (30)	7.5Y 8/8 (37)
5YR 7/10 (3)	2.5R 5/14 (10)	2.5G 5/2 (17)	10PB 3/10 (24)	7.5PB 6/8 (31)	7.5Y 8.5/8 (38)
5YR 7/6 (4)	2.5R 5/4 (11)	2.5G 7/4 (18)	10PB 3/6 (25)	7.5PB 4/12 (32)	7.5Y 6/8 (39)
5YR 5/6 (5)	2.5R 5/8 (12)	2.5G 5/4 (19)	10PB 5/10 (26)	7.5PB 4/6 (33)	7.5Y 9/4 (40)
5YR 7/4 (6)	2.5R 4/10 (13)	2.5G 6/10 (20)	10PB 6/10 (27)	7.5PB 4/8 (34)	7.5Y 7/8 (41)
5YR 6/12 (7)	2.5R 6/12 (14)	2.5G 8/8 (21)	10 PB 5/6 (28)	7.5PB 6/6 (35)	7.5Y 6/4 (42)

APPENDIX B: Colour pairs, which are selected twice or more

RITs	Comfort	Uncomfo	Pleasant	Unplea	Beautiful	Ugly	Elegant	Vulgar	Cold	Warm	Masculine	Feminine	Discreet	Loud
Ent	15 40 (2)  40 42 (2)	NA	15 40 (2) 	NA	6 42 (2) 	1 5 (2) 	18 40 (2) 	1 16 (2)  1 5 (2) 	15 40 (3)  9 15 (2) 	2 3 (3) 	31 32 (2)  32 34 (2)  33 34 (3) 	8 10 (2)  9 10 (3) 	15 40 (2)  6 40 (3)  40 42 (2) 	NA
LR	NA	1 2 (2) 	11 17 (2) 	1 5 (2) 	6 40 (3)  11 17 (2) 	NA	6 40 (2)  11 40 (2)  39 40 (2) 	1 5 (3) 	24 35 (2) 	3 4 (2) 	33 34 (2)  17 40 (2)  1 5 (2) 	9 10 (3) 	15 40 (3)  6 40 (3) 	2 7 (2) 
Cor	15 40 (2)  4 6 (3) 	NA	15 40 (2)  18 40 (2)  4 6 (3) 	1 5 (2) 	6 42 (2) 	NA	15 40 (2) 	NA	15 40 (2)  9 15 (2) 	2 3 (3)  6 11 (2) 	31 32 (2)  33 34 (2) 	8 10 (2)  9 10 (2) 	15 40 (3)  6 40 (4)  40 42 (2) 	NA
K/D	35 40 (2)  6 18 (2)  40 42 (2) 	1 2 (2) 	15 18 (2) 	NA	40 42 (2) 	2 20 (3) 	4 40 (2)  6 40 (2)  40 42 (2) 	1 10 (2) 	NA	NA	32 33 (2)  17 42 (2)  24 25 (2) 	17 18 (2)  10 14 (2) 	6 40 (5) 	2 3 (2)  2 36 (2) 
Toi	17 39 (2)  4 40 (2)  6 40 (2)  14 26 (2) 	2 7 (2) 	14 26 (2) 	NA	NA	1 39 (2)  2 20 (3) 	6 40 (3)  39 40 (2) 	1 16 (2)  1 5 (2) 	18 19 (2) 	29 30 (2)  3 4 (2) 	33 34 (2)  25 32 (2) 	10 14 (2) 	15 40 (3)  6 18 (2)  6 40 (5) 	2 36 (2) 
WR	17 40 (2) 	NA	NA	NA	6 17 (2)  6 11 (2) 	2 20 (2) 	21 40 (3)  40 42 (3) 	1 39 (2)  2 20 (2) 	15 40 (2)  6 35 (2) 	2 3 (2)  38 40 (3) 	33 34 (2)  1 5 (5) 	8 10 (2)  11 17 (2) 	15 40 (2)  6 40 (3)  40 42 (2) 	NA
Bal	40 42 (4)  41 42 (2) 	NA	6 40 (2) 	1 5 (2) 	4 6 (2)  38 40 (2) 	1 2 (2)  1 5 (2) 	15 20 (2)  4 6 (3) 	1 16 (2) 	15 40 (2) 	2 3 (2) 	30 31 (2)  33 34 (2)  25 32 (2) 	8 10 (3) 	15 40 (4)  4 40 (2)  6 40 (2) 	2 3 (2) 
BR	17 39 (2)  4 40 (2)  6 40 (2)  14 26 (2) 	2 7 (2) 	NA	NA	NA	2 20 (3) 	6 40 (2)  39 40 (2) 	1 16 (2)  1 5 (3) 	NA	29 30 (2)  3 4 (2)  38 40 (2) 	33 34 (2)  25 32 (2) 	10 14 (2) 	15 40 (2)  6 18 (2)  6 40 (4) 	NA
KR	15 40 (2)  28 35 (2) 	NA	NA	NA	15 40 (2) 	1 2 (2)  1 5 (2) 	NA	1 5 (5)  1 39 (2) 	NA	4 40 (2) 	23 29 (2)  25 32 (2) 	4 40 (2)  8 9 (2)  8 10 (3) 	15 40 (2)  6 40 (4) 	2 36 (2)  3 7 (2) 
BER	15 29 (2)  17 40 (2) 	2 21 (2) 	11 40 (2) 	20 27 (2) 	NA	1 2 (2)  1 5 (2)  2 20 (2) 	4 6 (3)  4 42 (2)  6 11 (2) 	1 5 (4)  1 13 (2) 	NA	NA	NA	6 11 (2)  8 10 (3) 	6 40 (4) 	13 17 (2) 